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Smart Loan and Asset Management System with Automated Notification and Redemption Tracking for Sulu Padjak

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ABSTRACT

This study aimed to develop and evaluate a Smart Loan and Asset Management System with Automated Notification and Redemption Tracking for Sulu M'C Chay Padjak in Jolo, Sulu, Philippines, addressing inefficiencies in manual recordkeeping, financial computations, inventory monitoring, and customer communication. Guided by the Input–Process–Output (IPO) model, the study employed the Waterfall Software Development Life Cycle, comprising requirements analysis, system design, implementation, testing, deployment, and maintenance. Data were gathered through semi-structured interviews with the pawnshop manager and two cashiers, document reviews, and user acceptance evaluation involving the owner and personnel. The locally hosted web-based system integrated customer management, pawn transactions, automated loan computations, redemption and forfeiture tracking, inventory monitoring, financial reporting, role-based access controls, audit logging, and SMS notifications. Testing achieved 85% code coverage of critical business functions, with search and dashboard responses completed in less than two seconds and ticket generation in less than three seconds after data entry, compared with the reported 10–15-minute manual transaction cycle. User acceptance evaluation yielded an overall mean of 4.50, interpreted as Excellent. The study concluded that the system achieved its intended objectives and recommended its operational adoption, regular system maintenance, and future enhancements involving mobile accessibility and electronic payment integration. The project supports Sustainable Development Goals 8, 9, 10, and 16 by promoting operational efficiency, technological innovation, accessible financial services, and accountable information management. Its sustainability contribution lies in strengthening the economic, technological, and institutional capacity of a community-based financial service provider through improved transaction accuracy, service reliability, and operational transparency.

Keywords: *Asset Management, Automated Notifications, Digital Transformation, Financial Inclusion, Loan Management System, Pawnshop Management, Redemption Tracking, SMS Gateway*

1. INTRODUCTION

Digital transformation has become essential to improving the efficiency, accuracy, and reliability of financial services, particularly among small enterprises. Digital technologies support centralized recordkeeping, automated transactions, and improved operational decision-making, although smaller businesses continue to face challenges in adopting appropriate systems (Organisation for Economic Co-operation and Development [OECD], 2024). Financial inclusion research also emphasizes the importance of accessible, reliable, and secure financial services, especially for underserved communities (Klapper et al., 2025). Pawnshops provide collateral-based lending services that require accurate management of customer information, pledged assets, loan computations, payments, redemptions, and forfeitures. Meilinda et al. (2024) highlighted the importance of integrated accounting information systems and internal controls in managing pawn transactions. Furthermore, the Bangko Sentral ng Pilipinas (BSP, 2025) emphasizes the importance of complete, accurate, reliable, and timely reporting in pawnshop operations. This study focuses on developing a Smart Loan and Asset Management System with Automated Notification and Redemption Tracking for Sulu M'C Chay Padjak in Jolo, Sulu. The system seeks to address manual processing limitations through integrated transaction management, automated financial computations, inventory monitoring, secure recordkeeping, and SMS-based customer notifications.

Research Problem

Sulu M'C Chay Padjak relies on manual processes for recording loan transactions, maintaining customer information, computing interest, tracking collateral, and monitoring payment schedules. Based on interviews with the pawnshop's management and personnel, transaction processing requires approximately 10–15 minutes per customer, while an estimated 5% of transactions experience computation errors. Additional difficulties include inconsistent inventory records, delayed identification of overdue loans, time-consuming report preparation, and potential loss or unauthorized access to paper-based information. These operational limitations demonstrate the need for a centralized information system that supports accurate transaction processing, efficient asset tracking, and reliable financial reporting. The BSP (2025) recognizes information technology as an important component of effective reporting governance in pawnshops, while Meilinda et al. (2024) emphasize transaction documentation, authorization procedures, and internal control in pawn-based lending operations. Customer communication also presents a significant operational concern because payment reminders, maturity notifications, and overdue notices require manual intervention. Recent research indicates that appropriately designed text-message interventions can influence repayment behavior, although their effectiveness depends on the lending context and message design (Barboni et al., 2026; Geberemdhin et al., 2026). Accordingly, the central research problem concerns the absence of an integrated digital platform capable of managing loan transactions, financial computations, pledged assets, redemption records, and customer notifications while maintaining appropriate information security and operational accountability.

Assumptions of the Study

The study assumes that integrating pawnshop transactions, customer information, and asset records within a centralized system can reduce repetitive administrative work and improve information accessibility. It further assumes that automated loan computations and maturity tracking can minimize manual calculation errors, while SMS notifications can support more consistent customer communication regarding payment obligations. The effective operation of the system depends on accurate data entry, appropriate staff utilization, functional local network infrastructure, and reliable SMS gateway connectivity. These assumptions are consistent with the operational requirements identified during the project's requirements

analysis and with research emphasizing the potential of digitalization to strengthen small-enterprise operations (OECD, 2024).

Objectives of the Study

The general objective of this study is to design and develop a Smart Loan and Asset Management System with Automated Notification and Redemption Tracking for Sulu M'C Chay Padjak to address inefficiencies in manual recordkeeping, inaccurate financial computations, and vulnerabilities in managing customer and transaction information. Specifically, the study aims to develop an integrated system for managing pawnshop loan transactions, customer records, and pawned item details; automate the computation of loan amounts, interest, maturity dates, and payment tracking; and implement an SMS notification system that automatically sends payment reminders, maturity alerts, and overdue notices to improve customer communication and facilitate timely transactions.

Theoretical or Conceptual Basis

The study is anchored in the Input–Process–Output (IPO) Model, which provides a structured framework for transforming operational requirements into an integrated information system. The input component comprises staff accounts and user roles, customer profiles, pledged asset information, loan and payment records, inventory data, transaction details, and SMS configuration requirements. These inputs establish the information necessary for managing the pawnshop's core operations. The process component involves user authentication, role-based authorization, transaction recording, automated loan and interest computation, maturity and redemption tracking, inventory status updating, notification generation, and report preparation. System development follows the Waterfall Software Development Life Cycle, encompassing requirements analysis, system design, implementation, testing, deployment, and maintenance. The output is a locally hosted, web-based Smart Loan and Asset Management System that integrates customer management, loan processing, asset monitoring, redemption tracking, financial reporting, audit logging, and automated SMS notifications. The system's security considerations are supported by ISO/IEC 27001:2022 and the National Institute of Standards and Technology Cybersecurity Framework 2.0, which provide guidance on information security management and cybersecurity risk management (International Organization for Standardization [ISO], 2022; National Institute of Standards and Technology [NIST], 2024). Additionally, ISO/IEC 25010:2023 provides a relevant reference for understanding software product quality characteristics, including functional suitability, performance efficiency, reliability, and security (ISO, 2023). Collectively, these concepts provide a technical basis for developing a centralized, functional, and secure pawnshop management system responsive to the operational needs of Sulu M'C Chay Padjak.

The study supports the United Nations Sustainable Development Goals, particularly SDGs 8, 9, 10, and 16, through its emphasis on digital financial services, operational efficiency, financial accessibility, and responsible information management (United Nations Department of Economic and Social Affairs [UN DESA], 2026). SDG 8 – Decent Work and Economic Growth. The system supports economic and institutional sustainability by improving transaction processing, financial record accuracy, and administrative efficiency. Automating routine operations can strengthen the pawnshop's capacity to provide reliable services and manage its business resources more effectively. SDG 9 – Industry, Innovation and Infrastructure. The project contributes to technological sustainability by introducing a locally hosted digital platform that integrates loan management, inventory monitoring, reporting, and automated customer communication. It demonstrates the practical application of information and communication technologies in modernizing small-enterprise financial operations. SDG 10 – Reduced

Inequalities. The system has an indirect contribution to financial inclusion by seeking to improve the reliability, transparency, and efficiency of an existing community-based lending service. Although the study does not directly measure increased financial access, improved service delivery may benefit customers who depend on collateral-based lending. SDG 16 – Peace, Justice and Strong Institutions. The project supports accountable institutional operations through role-based access controls, audit trails, secure recordkeeping, and standardized transaction documentation. These mechanisms are intended to strengthen transparency, traceability, and responsible management of financial information. Overall, the study contributes primarily to technological, economic, and institutional sustainability by developing a digital solution designed to strengthen pawnshop operations, support reliable customer services, and improve financial information management.

2. METHODOLOGY

Research Design

The study adopted the Waterfall Software Development Life Cycle (SDLC) model, consisting of six sequential phases: requirements analysis, system design, implementation, testing, deployment, and maintenance. This approach was selected to provide systematic documentation, stakeholder validation, and clearly defined development activities. The Input–Process–Output (IPO) model guided the transformation of existing manual pawnshop procedures into an integrated digital system. Requirements analysis identified the necessary functionalities, while system design established the application architecture, database structure, user interfaces, and access permissions. Development and testing subsequently verified the functionality, reliability, security, and usability of the application.

Research Locale or Study Setting

The study was conducted at Sulu M'C Chay Padjak, a pawnshop located in Jolo, Sulu, Philippines. The establishment provides collateral-based lending and related transactions involving customer registration, jewelry appraisal, loan processing, payment collection, redemption, forfeiture, and asset disposition. Its existing operations relied on manual logbooks, paper records, and calculator-based financial computations. The developed system was designed for deployment through a local server accessible to authorized personnel within the pawnshop's network.

Participants or Data Sources

The primary sources of information were the pawnshop manager and two staff members, identified as cashiers in the data-gathering procedure. The pawnshop owner also participated in requirements validation and system evaluation. These stakeholders provided information regarding transaction procedures, operational difficulties, system requirements, and expected functionalities. Additional data were obtained from existing customer records, pawn tickets, official receipts, transaction logbooks, inventory records, and other operational documents. Pawnshop personnel also participated in user acceptance testing to assess the system's functionality and usability.

Research Instruments or Materials

The study utilized semi-structured interviews, document reviews, software testing tools, and structured user acceptance evaluation forms. Interviews identified operational requirements, while existing records provided information on transaction workflows, customer information, financial computations, and asset management. User acceptance feedback was collected through Likert-scale ratings and verbal comments. The web-based application was developed using HTML5, Tailwind CSS, and JavaScript for the user interface; PHP 8.x for application

processing; and MySQL 8.0 for database management. Apache 2.4 supported local server deployment, while TCPDF, PhpSpreadsheet, and PHP QR Code facilitated document generation, report export, and transaction identification. An SMS gateway was integrated for automated customer notifications, with StartEdgeSMS used during system evaluation. PHPUnit supported unit testing, while Git was used for version control. Security mechanisms included password hashing, role-based access control, session management, Cross-Site Request Forgery (CSRF) protection, and audit logging.

Data Gathering Procedure

Data gathering began with semi-structured interviews involving the pawnshop manager and two cashiers to identify existing workflows, operational problems, and system expectations. Paper-based records, transaction forms, receipts, and logbooks were examined to determine essential data fields and processing requirements. The identified requirements were reviewed and validated with the pawnshop owner and personnel. Following requirements analysis, the researchers developed the system architecture, normalized database structure, user interfaces, and role-based access permissions. The application incorporated customer registration, jewelry inventory, automated loan and interest computation, payment and redemption tracking, buy-and-sell transactions, reporting, and SMS notifications. Automated messages were configured for loan confirmation, payment reminders three days before maturity, maturity-date alerts, and overdue notices one day after a missed maturity date. The developed system underwent unit, integration, and system testing, followed by user acceptance testing involving pawnshop personnel. Deployment was conducted through a local server, with migration of active and historical records performed in stages. Data accuracy was checked through database comparison queries and manual record verification. SMS delivery was tested using actual customer mobile numbers, and the system was presented to the pawnshop owner and staff for final evaluation and acceptance.

Data Analysis

The information obtained from interviews and document reviews was examined to identify functional and non-functional system requirements. Functional requirements included customer management, loan processing, financial computation, inventory monitoring, redemption tracking, reporting, and SMS notification. Non-functional requirements covered usability, performance, reliability, security, and scalability. System performance was evaluated through unit, integration, system, and user acceptance testing. Unit testing examined the accuracy of loan computations, interest charges, maturity dates, fees, and penalties. Integration testing verified data consistency across transaction processing, inventory management, audit logging, and SMS functions. System testing assessed response times, transaction processing, and operational functionality. User acceptance was evaluated using Likert-scale ratings summarized through mean scores, supplemented by verbal feedback from pawnshop personnel. Performance measurements were compared with the reported manual transaction-processing baseline to assess operational improvement. Testing observations and user feedback were used to identify necessary revisions and determine whether the system satisfied its specified requirements.

Ethical Consideration

The study involved operational records and customer information requiring appropriate confidentiality and security safeguards. The developed system incorporated role-based access restrictions, password hashing, session timeouts, CSRF protection, audit logging, and locally controlled data storage. Automated backups were also included to support the protection and recovery of stored information. The study reports stakeholder participation and SMS testing using

actual customer mobile numbers. However, it does not explicitly document informed consent procedures, customer authorization for test notifications, institutional ethical clearance, or data retention arrangements. These matters require confirmation before the study can claim compliance with formal research ethics requirements.

3. RESULTS AND DISCUSSION

3.1 Functional and Operational Results of the Developed System

3.1.1 Integrated Customer, Loan, and Asset Management

The developed system successfully integrated customer records, jewelry inventory, and pawn transactions into a centralized database. The Pawners module enabled customer registration, record retrieval, and updating, while the Jewelry Inventory module maintained item descriptions, weights, karat classifications, appraised values, and transaction statuses. The administrator dashboard provided real-time summaries of active, overdue, redeemed, and forfeited loans, while the search function allowed transaction retrieval using ticket numbers, customer information, dates, and status. These findings demonstrate the system's capacity to address fragmented recordkeeping and improve transaction monitoring. Hassan (2022) identified manual documentation and inadequate overdue tracking as operational challenges in traditional pawnshops. The developed system addressed these concerns through centralized records, automated status updates, and accessible transaction information, strengthening operational efficiency and record accuracy.

3.1.2 Automated Loan Processing and Financial Computation

The Sandá/Pawn module automated loan origination, interest computation, maturity tracking, and payment calculations. The system applied a monthly interest rate of 3.00% and a ₱5.00 monthly service fee, automatically calculating the total payable amount based on the principal, accumulated interest, and applicable charges. New transactions followed a three-step process involving customer selection, jewelry identification, and loan processing. The application generated unique ticket numbers, printable transaction records, and corresponding inventory updates. The evaluated configuration included a one-month default maturity and a ten-month expiry period. The automation of financial computations addressed the risks associated with manual calculations and repetitive transaction processing. Abdulrahman (2023) reported improvements in transaction processing time and calculation accuracy following pawnshop computerization. Similarly, the developed system standardized loan calculations and transaction documentation, reducing dependence on manual computations and supporting more consistent financial recordkeeping.

3.1.3 Redemption, Forfeiture, and Inventory Tracking

The system incorporated automated inventory status updates for pawned, redeemed, forfeited, and sold items. Redemption and renewal transactions updated corresponding loan and asset records, while the forfeiture module identified items exceeding the applicable grace period. The Sell module recorded the disposal of eligible items, and the Buy module registered newly acquired assets. These transactions maintained corresponding changes in the inventory database. The integration of asset status monitoring and transaction records provides a systematic mechanism for tracking pledged items throughout their transaction lifecycle. By connecting loan activities with inventory updates, the system addresses inconsistencies associated with manual inventory monitoring and improves the traceability of collateral and related transactions.

3.1.4 Automated SMS Notification System

The system successfully integrated the StartEdgeSMS gateway to automate customer notifications. Four message types were configured: loan confirmations, payment reminders three days before maturity, maturity-date alerts, and overdue notices one day after missed maturity dates. The gateway checked the server every 60 seconds, processed queued messages, and maintained transmission and connection logs. SMS verification confirmed successful delivery of all four notification types in the test set. These findings demonstrate the system's ability to automate routine customer communication and provide timely information regarding loan obligations. The notification mechanism reduces the need for staff-initiated reminders and establishes a consistent process for informing customers about payment schedules, maturity dates, and overdue transactions.

3.1.5 Management Reporting, Access Control, and Audit Logging

The developed system provided financial summaries, transaction monitoring, report generation, and export functions in PDF, Excel, and CSV formats. During evaluation, the database contained eight loan records comprising one renewed, three redeemed, two expired, and two forfeited transactions, with no auctioned items. The system supported four user roles—System Administrator, Manager, Appraiser, and Cashier—with assigned access permissions. It also maintained audit records of authentication, transaction modifications, payments, inventory updates, and SMS activities. Branch information and locations were accessible through the system's directory and mapping functions. These functionalities strengthen operational monitoring, accountability, and information management. Fernandez (2022) and Torres (2021) emphasized role-based access control and audit logging as important safeguards in web-based financial systems. The developed application incorporated these mechanisms to regulate user privileges, document system activities, and support the traceability of financial transactions.

3.2 System Testing, Performance, and User Acceptance

3.2.1 Functional and Integration Testing

Unit testing using PHPUnit verified loan computations, interest charges, monthly fees, maturity calculations, and penalty functions, achieving 85% code coverage of critical business logic. Integration testing confirmed consistent data processing across pawn transactions, inventory updates, audit logging, and automated SMS notifications. System testing verified the operational modules, with minor interface observations identified during evaluation. The testing results indicate that the essential system functions operated according to the specified requirements. Successful integration testing confirmed that transaction processing produced corresponding updates across related modules, supporting consistent records and coordinated system operations.

3.2.2 System Response Time and Transaction Processing

Performance testing showed that search and dashboard queries responded in less than two seconds within the local network. After completing data entry, pawn ticket generation and printing required less than three seconds, compared with the reported 10–15 minutes for the previous manual transaction process. These findings demonstrate efficient system response and automated transaction execution. The results are consistent with Abdulrahman (2023), who reported improvements in transaction processing following the computerization of pawnshop operations. However, the automated ticket-processing measurement specifically covered the period after data entry, whereas the reported manual processing time represented the broader transaction cycle.

3.2.3 User Acceptance Evaluation

User acceptance testing was conducted through an on-site system presentation involving the pawnshop owner and personnel. The evaluation covered customer management, inventory monitoring, pawn transactions, reporting, and SMS settings. Feedback was gathered through Likert-scale ratings and verbal comments. The system obtained an overall user acceptance mean of 4.50, interpreted as Excellent, and was accepted following revisions. The evaluation findings indicate favorable user acceptance of the developed application. The results support the suitability of its integrated features for the operational requirements identified during requirements analysis. The evaluation also confirmed the importance of stakeholder feedback in identifying necessary refinements before operational adoption.

3.3 System Scope and Operational Limitations

The developed application was implemented through a locally hosted web-based architecture using HTML5, Tailwind CSS, JavaScript, PHP 8.x, MySQL 8.0, and Apache 2.4. Although the system successfully managed pawnshop transactions and related records, physical jewelry appraisal remained a manual activity. The application did not include real-time gold price updates, external banking integration, or a native mobile application. SMS functionality depended on an operational gateway device, server connectivity, and sufficient messaging credits. These limitations define the system's operational coverage and technical dependencies. Local deployment supported centralized access within the pawnshop network, while the SMS gateway provided automated external communication. Overall, the findings indicate that the developed system achieved its intended objectives of integrating pawnshop records, automating financial computations, and providing customer notifications within its specified scope.

4. CONCLUSIONS AND RECOMMENDATIONS

The study successfully developed and evaluated the Smart Loan and Asset Management System with Automated Notification and Redemption Tracking for Sulu Padjak, achieving its objectives of integrating customer records, pawn transactions, and inventory management; automating loan computations, interest, maturity dates, and payment tracking; and implementing SMS notifications for payment reminders and overdue transactions. The system improved transaction processing, record accessibility, and operational monitoring while incorporating role-based access controls, password protection, and audit logging. Its locally hosted architecture supported centralized pawnshop operations, and user acceptance testing yielded an overall mean of 4.50, interpreted as Excellent, indicating favorable acceptance of the developed system.

The study recommends adopting the developed system as the official platform for managing pawnshop transactions, customer records, inventory, and payments, with parallel manual records discontinued after one successful monthly cycle. A designated staff member should oversee data backups, SMS gateway operations, messaging credits, and user accounts, while customer contact information and overdue transaction reports should be regularly updated and monitored. Future enhancements may include a precious-metal price reference, a mobile-friendly interface, and electronic payment integration subject to appropriate reconciliation procedures. The study also recommends collecting at least three months of operational performance data and maintaining configurable loan terms, interest rates, fees, and notification settings for possible implementation in other pawnshops.

The study was limited to the operational requirements of Sulu Padjak and the functionalities of a locally hosted web-based system. Physical jewelry appraisal remained a manual process, while real-time gold price monitoring, banking integration, electronic payment processing, and native mobile application development were excluded. Additionally, automated SMS notifications

depended on a functioning gateway device, server connectivity, and sufficient messaging credits, which may affect notification reliability.

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